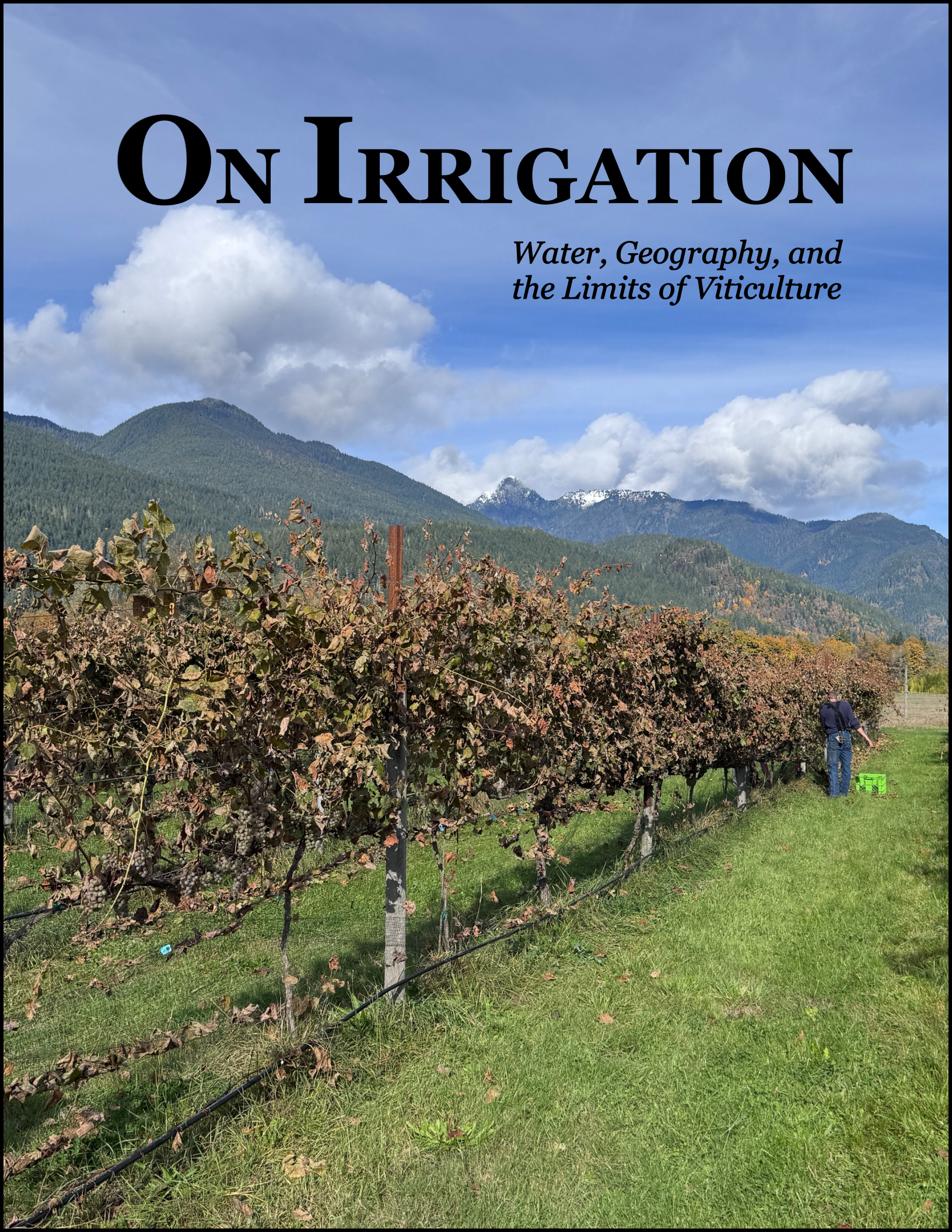
# On Irrigation

*Water, Geography, and the Limits of Viticulture*



***Cover:*** *The author's own experimental planting of Albariño in Washington State's Upper Skagit Valley, shown in late October 2025. The site receives 80 inches (two meters) of annual rainfall, yet requires deficit irrigation during summer drought— a consequence of excessively drained deep sandy soils. It is, in the terms this essay develops, a defensible use of water.*

# ON IRRIGATION

*Water, Geography, and the Limits of Viticulture*

Wine is among the most geographically specific of agricultural products. For most of its history, viticulture occupied a narrow band of the earth's surface — not by convention or regulation, but by necessity. The vine requires a precise convergence of conditions: sufficient warmth to ripen fruit, sufficient cold to enforce dormancy, sufficient diurnal variation to preserve acidity through the ripening cycle, and sufficient rainfall to sustain the vine through its biological calendar without overwhelming the soil drainage that root health requires. Where those conditions converged, wine was made. Where they did not, other crops were grown.

## I. THE NATURAL BASELINE

That geography was not arbitrary. It was the residue of centuries of empirical selection — of varieties, of sites, of practices — operating under the single constraint that the vine must complete its annual cycle with the resources the climate provides. The regions where the vine struggled most productively, where ripening arrived late and slowly, where acidity and sugar resolved together through a long growing season, produced the wines most worth drinking, most worth aging, and most compatible with human health. Burgundy, Bordeaux, Champagne, the Mosel, Piemonte, Rioja, and Ribera del Duero are not accidents of history. They are the residue of a long experiment conducted without scientific apparatus but with rigorous commercial consequence.

The common denominator across these regions is not warmth but tension — the productive tension between sufficient heat to ripen and sufficient cool to preserve. Elevation compensates for latitude: the Ribera del Duero plateau at 2,624 feet (800 meters) produces cool nights despite its inland position, preserving the acidity that its latitude might otherwise surrender. The Mosel's steep slate slopes capture and retain solar radiation that flat terrain at the same latitude cannot access. In each case, the site was selected because it solved a specific problem — how to ripen grapes completely in a climate that offered no margin for error.

A grape that reaches fermentable sugar levels through a long, slow, thermally moderate growing season arrives at harvest with a biochemical profile that irrigation cannot replicate: tartaric acid dominant, malic acid partially degraded through the ripening

process, phenolic compounds fully developed, aromatic precursors resolved. This is the profile that produces wine biologically stable without heavy chemical intervention, structurally integrated with food, and compatible with the ancestral model of consumption that the health literature, when it differentiates at all, finds most benign.

That map has been redrawn in the past century. The instrument of redrawing is irrigation.

## II. THE MANUFACTURED GEOGRAPHY

The expansion of viticulture beyond its natural boundaries is a twentieth-century phenomenon, made possible by irrigation and refrigeration in combination. Irrigation allowed vines to be established in regions where annual rainfall was insufficient to sustain them through the growing season. Refrigeration allowed the resulting wines to be stabilized and transported without the biological integrity that natural acidity provides. Together they dissolved the geographic constraint that had defined viticulture for millennia.

The distinction between the industrialization of traditional viticultural regions and the creation of viticulture in climatically unsuitable terrain is important. La Mancha, occupying Spain's central plateau at elevations above 2,460 feet (750 meters), is a legitimate viticultural region with centuries of history — home to Airén, for decades the world's most extensively planted grape variety. What irrigation brought to La Mancha was not viticulture but exponential volume: the transformation of a low-yield, drought-adapted tradition into an industrial supply chain. Some producers are now returning to low-yield, minimally irrigated expressions of Airén with results that demonstrate the variety's genuine if modest potential. The region's problem was not geography but scale.

The more fundamental case against irrigation concerns terrain with no natural viticultural history: the irrigated valleys of California's Central Valley, the deserts of the American Southwest and Mexico, the river flats of South Australia, the high desert of Argentina's Mendoza at lower elevations, where without supplemental water no viticulture would exist. Here irrigation does not industrialize a tradition — it manufactures a geography.

In these conditions, grapes present a distinctive and problematic biochemical profile. Without the mild water stress that naturally slows ripening and allows acidity to integrate, vines in warm irrigated conditions direct energy toward vegetative growth rather than fruit development, diluting concentration and disrupting the gradual acid stabilization that slow ripening achieves. The result is a grape that arrives at fermentable sugar levels while physiologically immature: malic acid dominant, unstable, requiring tartaric acid additions, cultured yeasts, fining agents, and filtration to achieve the stability that natural acidity provides without assistance.

A second and distinct failure mode operates at the opposite extreme. Where harvest is delayed in pursuit of the phenolic maturity — full color, tannin, and aromatic development — that the scoring system learned to reward, acidity degrades as sugar accumulates beyond the point of balance. The wine is overripe rather than unripe, but equally dependent on intervention: glycerin to soften tannin astringency, reverse osmosis to reduce alcohol after the fact, micro-oxygenation to simulate a development the wine's chemistry cannot achieve naturally.

Both failure modes — unripe and overripe — share a common origin in the application of water to terrain the vine's natural cycle cannot complete without it. The additive load that results is not incidental. It is the cumulative consequence of every point at which water substituted for climate and chemistry substituted for biology.

## III. THE INTELLIGENT USE OF WATER

The argument against manufactured viticultural geography is not an argument against water. It is an argument about purpose.

Three applications of irrigation are defensible on quality grounds and consistent with the geographic thesis advanced here.

**Establishment.** Young vines, before their root systems have penetrated to the subsoil moisture reserves that sustain mature vines through dry seasons, are vulnerable to water stress unrelated to the long-term character of the site. Irrigation during establishment — typically the first three to five years — allows root development to proceed without interruption, after which the vine can be weaned progressively toward the deficit conditions that define its mature expression. This is patient site development, not manufactured geography.

**Drought compensation in viable viticultural climates.** Climate change is imposing water deficits on traditional regions whose long-term rainfall patterns are shifting. The Douro Valley, Rioja's upper reaches, the higher elevations of Ribera del Duero — regions whose viticultural identity was formed under rainfall regimes no longer reliable — face a choice between adaptive irrigation and the loss of vineyards representing centuries of site selection and varietal adaptation. Targeted deficit irrigation applied at specific growth stages — sufficient to prevent the vine from entering survival stress that disrupts maturation, insufficient to drive the vegetative growth and dilution that uncontrolled irrigation produces — is a defensible response to a climatic reality the nineteenth-century viticulturalist did not face.

**Climate change adaptation.** As thermal boundaries shift northward and upward, regions at the southern and lower limits of the viticultural envelope are becoming unreliable. The appropriate response is not to sustain viticulture in regions the climate is abandoning through ever-greater water inputs, but to follow the envelope as it

migrates — to higher elevations in traditional regions, to cooler coastal exposures, to the northern latitudes where reliable ripening is becoming newly possible.

The single criterion that distinguishes defensible from indefensible irrigation applies in every case: does this water allow the vine to complete what the climate would otherwise support, or does it manufacture a viticultural geography the climate cannot sustain?

## IV. CLIMATE CHANGE AND THE RECALIBRATION

The irrigation argument does not weaken under climate change. It sharpens.

Water scarcity is already the binding constraint on agricultural expansion across the western United States, southern Europe, and Australia — precisely the regions where irrigated viticulture expanded most aggressively in the second half of the twentieth century. Central Valley aquifers are being drawn down at rates groundwater recharge cannot match. The Colorado River arrives at the Mexican border as a mere trickle. The Murray-Darling basin is the subject of permanent political conflict over allocation. Spain's interior rivers, diverted to support agriculture in regions receiving less than 300 millimeters of annual rainfall, are diminishing. These are not temporary disruptions. They are structural constraints that will tighten as warming reduces snowpack, accelerates evapotranspiration, and increases the frequency and severity of drought years.

The recalibration is already occurring, driven by economics rather than principle. Vineyards in California's Central Valley are being fallowed as water costs rise and bulk wine prices decline. Australian producers are consolidating onto higher-elevation, cooler, lower-irrigation-demand sites. Spanish producers are returning to Atlantic-influenced northern regions after decades of expansion into the Mediterranean interior. The market is doing slowly and painfully what a coherent water-use policy might have accomplished with less waste.

Climate change simultaneously opens new terrain. Southern England, producing sparkling wines of genuine quality from Chardonnay and Pinot Noir on chalk soils identical to Champagne's, will expand as warming extends the reliable ripening window. Scandinavia, Germany's northern plain, higher elevations across traditional regions — areas where viticulture was historically impossible or marginal — are developing genuine potential without irrigation, because the climates receiving them are, by definition, climates the vine can sustain without supplementation.

The vine follows the climate. Water should not be used to prevent that migration from occurring.

## V. THE QUALITY CONSEQUENCE

The geographic argument produces the quality argument as a natural consequence.

Wine produced within natural viticultural geography tends toward the profile that both qualitative tradition and the emerging health literature identify as desirable: low residual sugar, low pH, biological stability, minimal intervention. Wine produced in manufactured geography tends toward the opposite, for the same reasons inverted — and the intervention that the vineyard necessitates continues at the winery and does not terminate at the bottle.

The correspondence between geographic legitimacy and wine quality is not coincidental. It is causal. The regions where the vine belongs, climatically and hydrologically, are the regions that have always produced the wines most worth drinking. That the same regions produce wines most compatible with human health is not a separate argument. It is the same argument, viewed from a different angle.

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### A Personal Note

As a pioneering importer of Spanish and German wines, the author was a featured speaker at the Society of Wine Educators' annual conferences during the 1990s. Intimately familiar with Spain's early-ripening Tempranillo on the high plateaus of Castile and Germany's late-ripening Riesling on the south-facing slopes of the Rhine and Mosel — he presented one year on what he termed A Paradox: that Tempranillo, an early-ripening variety, thrives at Spain's relatively southern latitudes, while Riesling, a late-ripening variety, thrives at Germany's extreme northern ones. The apparent contradiction resolves when latitude is replaced by the more precise concept of thermal calendar: each variety is matched not to a position on the map but to the specific shape of the season in which it completes its cycle. Moreover, the extreme elevation of Castile contrasts sharply with the nearly sea-level disposition of the Rhine. The argument of this essay is, in part, that insight extended.